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(54) ELECTRONIC CONTROL TYPE HYDRAULIC DRIVING MACHINE.

(57) This invention relates to an electronic control type hydraulic driving machine which does not require any exclusive equipment butpermits an unmanned operation through a remote control operation, can select and set easily each work mode by an external memory such as an IC card, and enables an operator to experience the operation of a vehicle or working machine by gripping an operation lever even during automatic operation. This machine includes an electronic control type hydraulic valve device (2) for making supply control of a pressure oil to hydraulic actuators (1a, 1b) for driving the working machine, an electronic controller (3) for the valve device, an electrical operation lever device (4) for outputting a lever operation signal and a work automation controller (8) for outputting an operation signal to the electronic controller. It may include further an external memory reader (18), a radio control reception controller (11) for the remote operation, a radio control/manual operation switching device (10), and the like.

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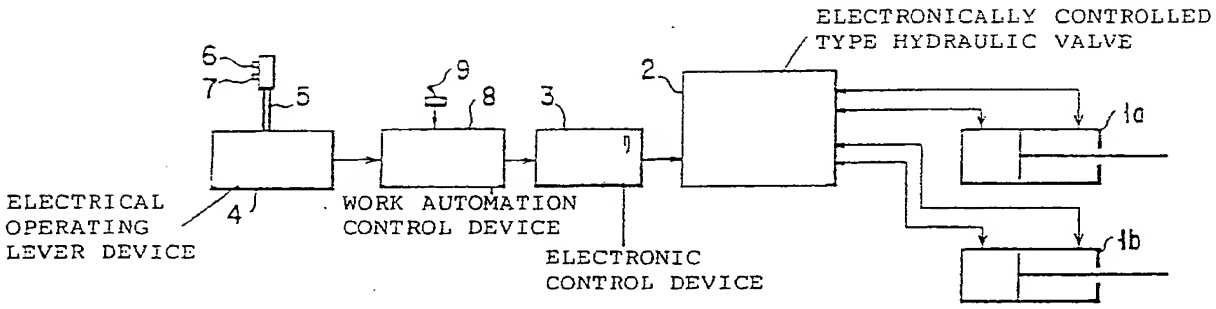
Fig. 2


ELECTRONICALLY CONTROLLED
TYPE HYDRAULIC VALVE
6
7
5
9
8
3
2
1a
1b
ELECTRICAL
OPERATING
LEVER DEVICE
4
WORK AUTOMATION
CONTROL DEVICE
ELECTRONIC
CONTROL DEVICE

TECHNICAL FIELD OF THE INVENTION

This invention relates to an earth moving vehicle for conducting excavation work and the like, and more particularly to an electronically controlled type hydraulically driven vehicle provided with an work automation control device so that it can automatically conduct an earth moving operation repeatedly.

BACKGROUND ART OF THE INVENTION

Prior art earth moving vehicles such as power shovels and the like having no work automation device have required provision of an equipment or a vehicle for exclusive use in order to conduct unmanned operation.

To conduct unmanned operations of the above-mentioned prior art vehicles, the scale of the equipment and the running cost thereof will become unavoidably very large and high.

Further, there are a variety of operational modes for automatic controls of such electronically controlled type hydraulically driven vehicle. In prior art automatic vibration modes out of such a variety of operational modes, the arrangement is made such that to select each of the automatic vibration modes each of switches b, c and d provided on a panel "a" as shown in Fig. 1 is manipulated.

In the above-mentioned prior art automatic vibration modes, selection of each of the modes requires complicated operations of the switches b, c and d on the panel "a".

For example, to set automatic vibration mode, it is required for the operator turn on and off each of a vibration mode change-over switch b, a vibration section selection switch c and a vibration width selection switch d to thereby select three or four necessary items.

Further, such electronically controlled type hydraulically driven vehicles are provided with a work automation control device which can fulfill functions of automatic vibration and teaching playback. However, either in automatic vibration mode or in teaching playback mode, when the work implement is conducting vibrational operation or operation based on the teaching, the operating lever remains to be stopped at its neutral position.

Such being the arrangement, there is a problem with the prior art electronically controlled type hydraulically driven vehicles in that the operator cannot feel actually operations of the work implement and the vehicle body in comparison with the case he operates the operating lever manually to conduct operations of the work implement and the vehicle body.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above-mentioned circumstances in the prior art, and has for its object to provide an earth moving vehicle wherein unmanned operation can be conducted simply without the need for provision of an equipment or vehicle for exclusive use and the unmanned operation can be conducted by remote control.

Another object of the present invention is to provide an electronically controlled type hydraulically driven vehicle wherein change-over of operational modes is not made by change-over of switches, and instead each operational mode can be selectively set simply by using an external storage device such as an IC card or the like.

A still further object of the present invention is to provide an electronically controlled type hydraulically driven vehicle arranged such that during a playback operation the operating lever is moved by a manipulated variable corresponding to the amount of work to be done by the work implement, and the operator can feel actually operations or movements of the work implement and the vehicle body by grasping the operating lever by his hand.

To achieve the above-mentioned principal object, according to a first aspect of the present invention, there is provided an electronically controlled type hydraulically driven vehicle comprising: a plurality of hydraulic actuators for actuating a work implement; an electronically controlled type hydraulic valve device for controlling fluid under pressure to be supplied to these hydraulic actuators; an electronic control device for sending a predetermined control signal to this hydraulic valve device; an electrical operating lever device for outputting a manipulated variable of an operating lever in the form of an electric signal; and a work automation control device adapted to store the operation signal transmitted by the electrical operating lever device and output the stored operation signal to the electronic control device when it receives a command of playback.

To achieve the above-mentioned second object, according to a second aspect of the present invention, there is provided an electronically controlled type hydraulically driven vehicle as set forth in the above-mentioned first aspect, characterized in that it comprises further an external storage reader connected with the work automation control device to read out the information stored in an external storage device such as an IC card or the like, the arrangement being made such that the work automation control device outputs a signal based on the signal read out by the external storage reader to the electronic control device.

To achieve the above-mentioned third object, according to a third aspect of the present invention, there is provided an electronically controlled type

hydraulically driven vehicle as set forth in the above-mentioned first aspect, characterized in that the electrical operating lever device comprises an actuator for actuating the lever attached thereto, and a control device connected with the work automation control device for controlling the actuator.

According to a fourth aspect of the present invention, there is provided an electronically controlled type hydraulically driven vehicle as set forth in the above-mentioned first aspect, characterized in that the work automation control device comprises a radio control/manual operation change-over device connected with the work automation control device and also connected with the electrical operating lever device, a ratio control signal receiving control device connected with the ratio control/manual operation change-over device, and an electrical operating lever device adapted to send a lever operation signal by wireless to the radio control signal receiving control device.

According to the present invention incorporating the above-mentioned aspects, unmanned operation can be conducted simply without having to use an equipment for exclusive use. Further, the unmanned operation can be conducted by radio control operation and the operational safety can be improved.

Further, change-over of operational modes is not mode by change-over of switches, and each of operational modes can be selectively set simply by using an external storage device such as an IC card or the like.

Further, in the electronically controlled type hydraulically driven vehicle provided with the work automation control device so that it can automatically conduct work repeatedly, during a playback operation the operating lever attached to the electrical operating lever device is moved by a manipulated variable corresponding to the amount of work to be done by the work implement, and the operator can feel actually operations or movements of the work implement or the vehicle body by grasping the operating lever by his hand so that he can realize the automatic repeating operation as actual feeling.

The above-mentioned and other objects, aspects and advantages of the present invention will become apparent to those skilled in the art by making reference to the following detailed description and the accompanying drawings in which preferred embodiments incorporating the principles of the present invention are shown by way of example only.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic front view showing a panel switch used in a prior art electronically controlled type hydraulically driven equipment,

Figs. 2 to 5 are block diagrams showing different embodiments of the present invention, and,

Fig. 6 is a block diagram showing a work automation control device for use in the embodiment as shown in Fig. 5.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention will now be described in detail below by way of several preferred embodiments thereof with reference to the accompnaying drawings.

Fig. 2 is a block diagram showing a first embodiment of the present invention. In the drawing, reference numerals 1a and 1b denote hydraulic actuators for actuating work implements of an earth moving vehicle such as a power shovel or the like, and 2 a hydraulic valve for controlling fluid pressure supplied to each of the hydraulic actuators 1a, 1b. This hydraulic valve 2 is of an electronically controlled type which is actuated by electronic control. Reference numeral 3 denotes a electronic control device for sending a predetermined control signal to the hydraulic valve 2.

Reference numeral 4 indicates an electrical operating lever device adapted to convert the turning angle of an operating lever 5 in the form of an electric signal. The operating lever 5 has a teaching switch 6 and a playback switch 7. Reference numeral 8 denotes a work automation control device which is controlled by the above-mentioned teaching switch 6 and playback switch 7 and adapted to store a lever operation signal transmitted by the electrical operating lever device 4 when the teaching switch 6 is turned on, and output the stored lever operation signal to the electronic control device 3 when the playback switch 7 is turned on. Further, the above-mentioned work automation control device 8 is adapted to be turned ON and OFF by means of a starting switch 9 mounted externally. When the starting switch 9 is turned OFF, the lever operation signal sent from the electrical operating lever device 4 is transmitted directly to the electronic control device 3 so that the manual operation can be conducted.

In the above-mentioned arrangement, the procedure to be taken in case of automatic operation of the earth moving vehicle will be described hereinbelow.

First of all, a skilled operator ride in the vehicle and turns the starting switch 9 and the teaching switch 6 on, and then manually operates the operating lever 5 of the electrical operating lever device 4. As a result, an operation signal which is in proportion to the turning angle of the above-

mentioned operating lever 5 is transmitted by the electrical operating lever device 4 through the work automation control device 8 to the electronic control device 3. Then, the electronic control device 3 will transmit a control signal to the electronically controlled hydraulic valve 2 to thereby actuate the latter so that the hydraulic actuators 1a and 1b are moved by an amount in proportion to the turning angle of the operating lever 5 of the above-mentioned electrical operating lever device 4, thereby conducting a predetermined earth moving operation. The manipulated variable of the operating lever 5 at that time is stored in the work automation control device 8. Stating in brief, the exact actions or movements of the hydraulic actuators 1a, 1b in an operation are stored in the work automation control device 8.

To conduct the above-mentioned stored actions automatically, the playback switch 7 is turned on. As a result, the above-mentioned lever operation signal stored in the work automation control device 8 is outputted to the electronic control device 3 so that the hydraulic actuators 1a and 1b will conduct repeatedly entirely the same operation as the above-mentioned manual operation.

At that time, if the playback switch 7 is installed on the outside of the vehicle, the above-mentioned repeating (playback) operation can be conducted without the operator riding in the vehicle, i.e., in unmanned condition.

While in the above-mentioned embodiment there is described the case of operating the hydraulic actuators 1a and 1b by means of the operating lever, it is not applicable only to operation of the operating lever, and in case of vehicles, by teaching data on running such as forward running, reversing and turning, etc. by means of the teaching switch, running operations can be conducted at the time of playback.

Fig. 3 shows a second embodiment of the present invention wherein an electrical operating lever device 4 and a radio control signal receiving control device 11 are connected through a radio control/manual operation change-over device 10 with a work automation control device 8, and an antenna box 12 is connected with the radio control signal receiving control device 11. Reference numeral 13 denotes an electrical operating lever device for radio control operational purposes. A lever operation signal generated by the electrical operating lever device 13 is sent under radio control (wireless control) to the above-mentioned antenna box 12. Reference numeral 14 indicates accessories such as a display unit or a buzzer, and 15 a vehicle condition detector such as a means for detecting engine's cooling water temperature or the like.

In this embodiment, when the radio control/manual operation change-over device 10 is changed over to the driver riding-in side, an operation similar to that in the case of the embodiment shown in Fig. 2 is made.

Whilst, when the radio control/manual operation change-over device 10 is changed over to the radio control operation side, a radio control operation is conducted by the electrical operating lever device 13 for radio control operational purposes.

In the next place, a third embodiment of the present invention will be described with reference to Fig. 4. Further, since the component parts indicated with the same reference numerals used in Figs. 2 and 3 are elements having the same functions, description of them is omitted herein to avoid duplication of explanation.

In this third embodiment, there is provided an electric motor 16 for actuating the operating lever 5 attached to the electrical operating lever device 4 so that the operating lever may be turned by the electric motor 16 in addition to manual operation. Further, the electric motor 16 is arranged to be controlled by a motor control device 17. The work automation control device 8 in this third embodiment is arranged to output a lever operation signal stored therein to the electronic control device 3 and the motor control device 17.

Automatic operation of a work implement by the electronically controlled type hydraulically driven vehicle is nearly the same as that in case of the first embodiment, but the arrangement is made such that when a lever operation signal is outputted from the work automation control device 8 to the electronic control device 3 the lever operation signal is also outputted to the motor control device 17 so that the electric motor 16 is driven in response to the output signal and the operating lever 5 attached to the electrical operating lever device 4 will conduct the same operation as that in case of the above-mentioned teaching operation. Therefore, the operator riding in the vehicle at that time can feel actually the operation of the earth moving vehicle by gripping lightly the operating lever 5 by his hand as if operation of the lever is made by himself.

Further, the electronic motor 16 provided on the above-mentioned electrical operating lever device 4 for actuating the operating lever 5 may be replaced by a hydraulic actuator.

In the next place, a fourth embodiment of the present invention will be described below with reference to Figs. 5 and 6. Further, since the component parts indicated with the same reference numerals used in Figs. 2, 3 and 4 are elements having the same functions, description of them is omitted herein to avoid duplication of explanation.

In the drawings, reference numeral 18 denotes an external storage reader adapted to read the

Fig. 3

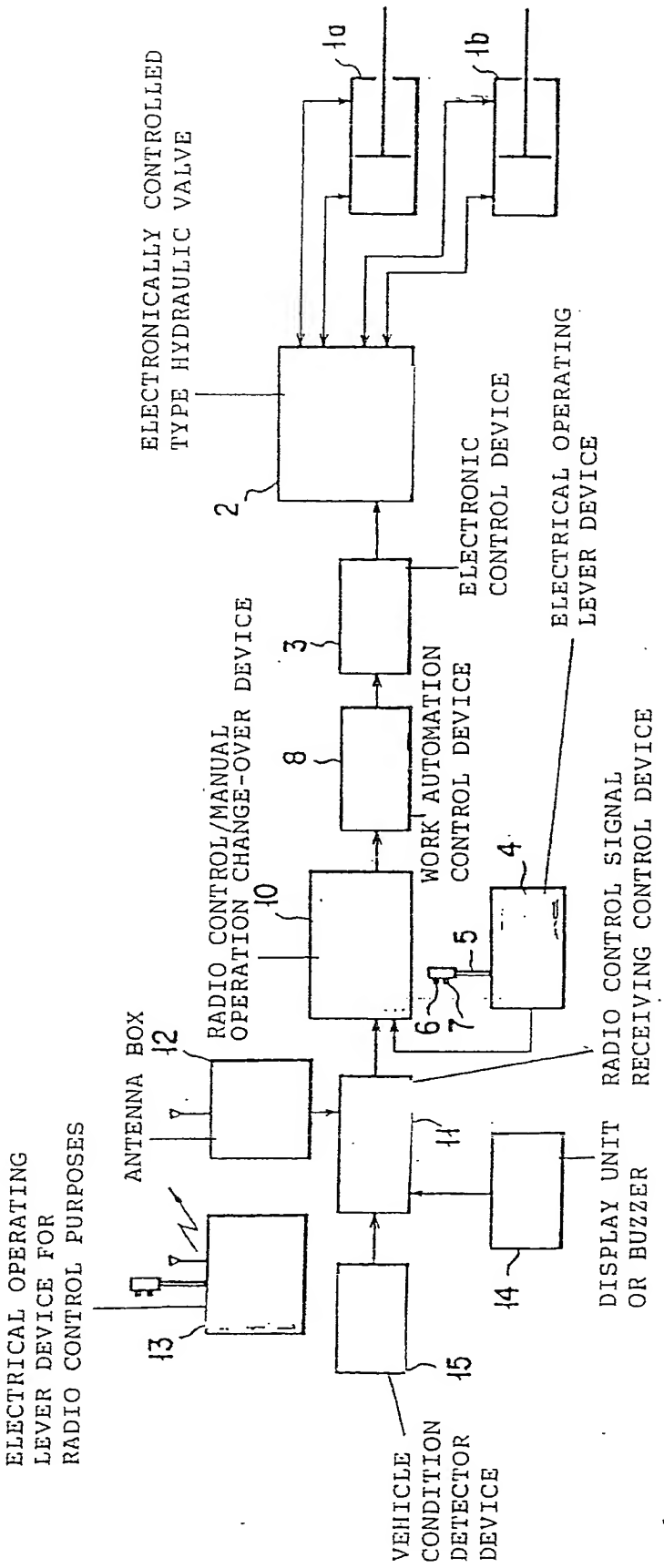

ELECTRONICALLY CONTROLLED TYPE HYDRAULIC VALVE
1a
1b
2
ELECTRONIC CONTROL DEVICE
3
WORK AUTOMATION CONTROL DEVICE
8
RADIO CONTROL/MANUAL OPERATION CHANGE-OVER DEVICE
10
ELECTRICAL OPERATING LEVER DEVICE
4
5
6
7
ANTENNA BOX
12
RADIO CONTROL SIGNAL RECEIVING CONTROL DEVICE
11
DISPLAY UNIT OR BUZZER
14
ELECTRICAL OPERATING LEVER DEVICE FOR RADIO CONTROL PURPOSES
13
VEHICLE CONDITION DETECTOR DEVICE
15

Fig. 4

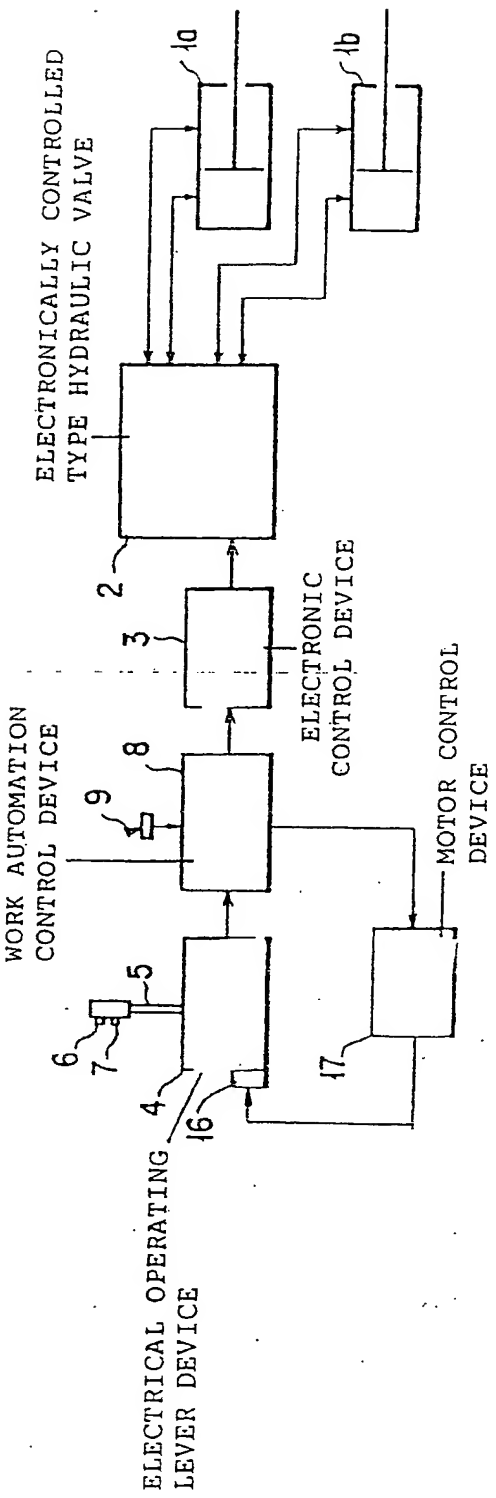

ELECTRONICALLY CONTROLLED TYPE HYDRAULIC VALVE
1a
1b
2
3
ELECTRONIC CONTROL DEVICE
WORK AUTOMATION CONTROL DEVICE
8
9
MOTOR CONTROL DEVICE
5
6
7
4
16
17
ELECTRICAL OPERATING LEVER DEVICE

Fig. 5

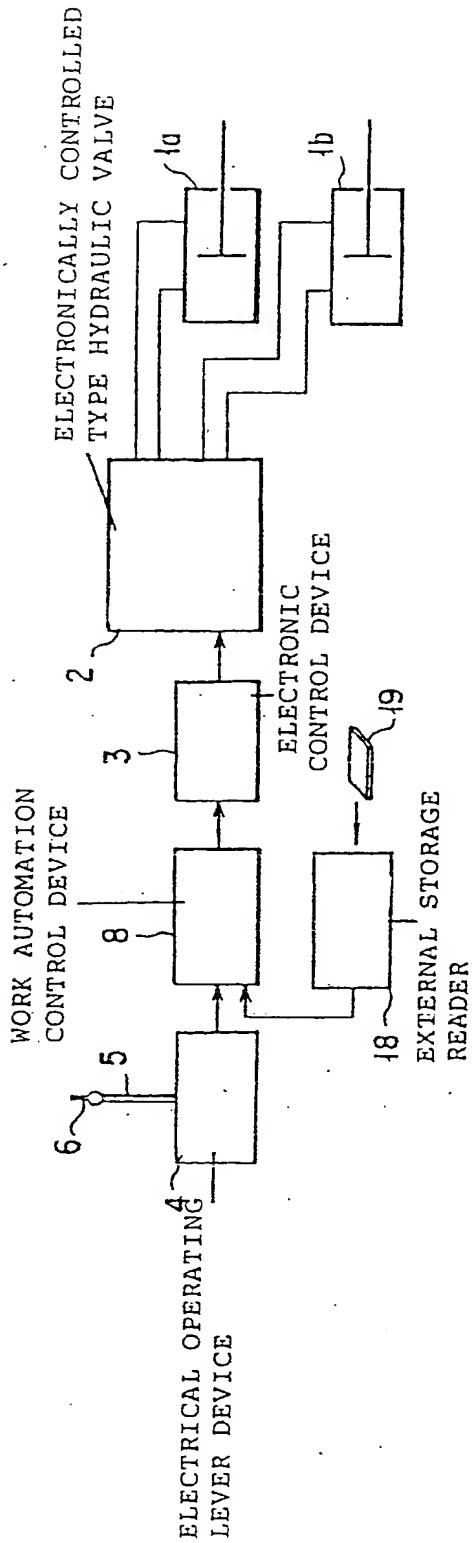
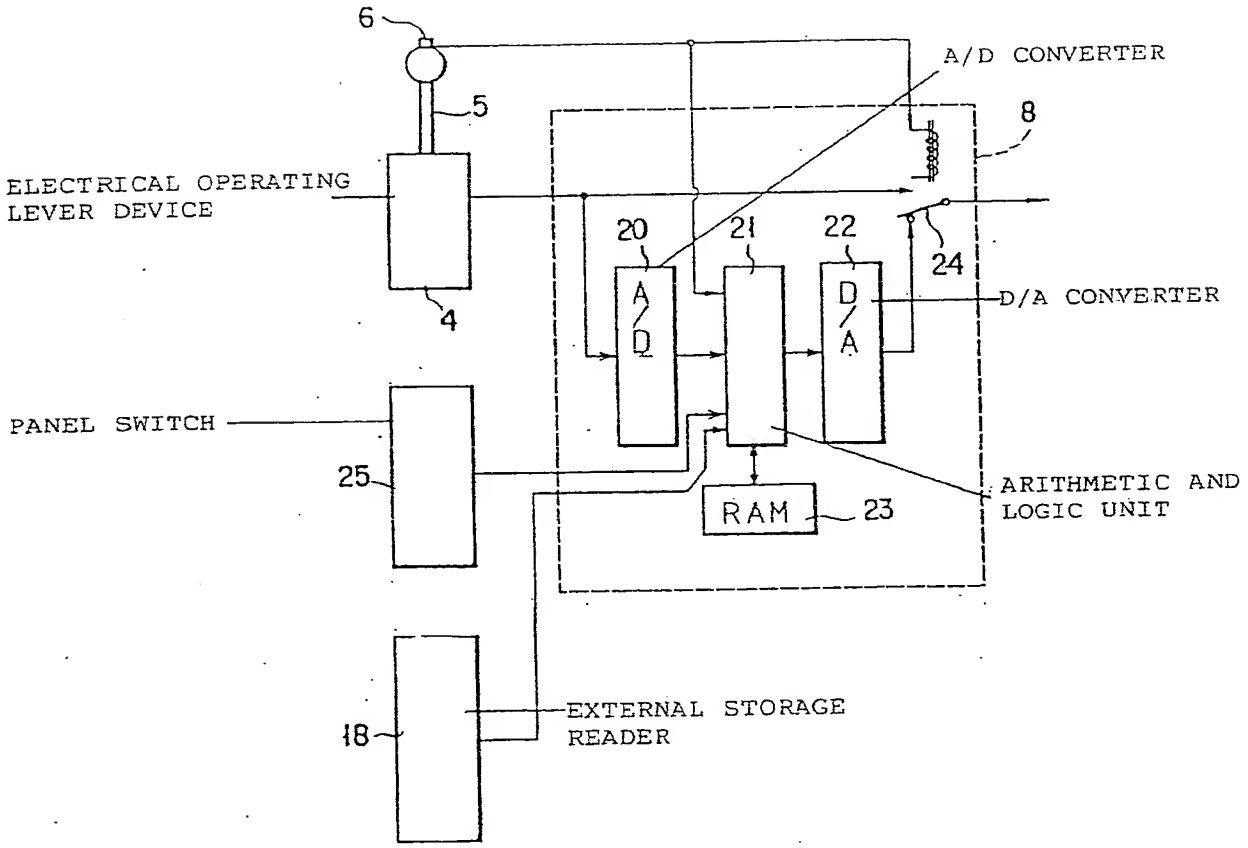

ELECTRONICALLY CONTROLLED TYPE HYDRAULIC VALVE
1a
1b
2
3
ELECTRONIC CONTROL DEVICE
19
WORK AUTOMATION CONTROL DEVICE
8
5
6
4
18
EXTERNAL STORAGE READER
ELECTRICAL OPERATING LEVER DEVICE

Fig. 6


6
5
A/D CONVERTER
8
ELECTRICAL OPERATING
LEVER DEVICE
20
21
22
24
A/D
D/A
D/A CONVERTER
4
PANEL SWITCH
25
RAM
23
ARITHMETIC AND
LOGIC UNIT
18
EXTERNAL STORAGE
READER

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP90/00267

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] E02F9/20

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	E02F3/42, 3/43, 9/20, 9/22

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1965 - 1989
Kokai Jitsuyo Shinan Koho	1972 - 1989

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	JP, A, 59-150837 (Hitachi Construction Machinery Co., Ltd.), 29 August 1984 (29. 08. 84), (Family: none)	1 - 6
Y	JP, A, 55-105034 (Kubota, Ltd.), 12 August 1980 (12. 08. 80), (Family: none)	1 - 6
Y	JP, B2, 55-2497 (Hitachi Construction Machinery Co., Ltd.), 21 January 1980 (21. 01. 80), (Family: none)	4
P	JP, U, 2-11854 (Komatsu Ltd.), 25 January 1990 (25. 01. 90)	2

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
May 7, 1990 (07. 05. 90)	May 21, 1990 (21. 05. 90)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	